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RADIOACTIVITY STANDARDS DISTRIBUTION PROGRAM, 1973-1974

National Environmental Research Center
Las Vegas, Nevada

February 1974

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A program for the distribution of calibrated radioactive samples is described. Included is a discussion of the objectives of the distribution program and a description of the preparation, availability, and distribution of calibrated radioactive samples. Instructions and application forms are included for laboratories desiring to participate in the program.

This document is not a research report. It is designed for use by personnel of laboratories participating or desiring to participate in the Radioactivity Standards Distribution Program which is a part of the U.S. Environmental Protection Agency's quality assurance program.

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1973 - 1974

by

Quality Assurance Branch
Technical Support Laboratory
National Environmental Research Center
Las Vegas, Nevada

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NATIONAL ENVIRONMENTAL RESEARCH CENTER
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U.S. ENVIRONMENTAL PROTECTION AGENCY
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PREFACE

Quality assurance is an integral part of any viable environmental monitoring activity. The primary goals of the Environmental Protection Agency's (EPA) quality assurance program are to improve and document the credibility of environmental measurements. To achieve these goals, quality assurance is needed in nearly all segments of monitoring activities and should cover personnel, methods selection, equipment, and data handling procedures.

Five major functions, each essential to an effective quality assurance effort, comprise EPA's quality assurance program:

- Promulgation of standardized methods of measurement
- Distribution of standard reference materials
- Issuance of guidelines and procedures
- Training and technical assistance
- Evaluation and certification of monitoring activities

This manual has been prepared to assist users of standard reference materials in the radiation area. All EPA monitoring programs are requested to make use of this document in planning their own radiation measurements and in assisting the States in carrying out radiation monitoring activities.

Comments concerning the utility of this document, along with any suggestions for possible changes and revisions, are welcomed. Questions on matters related to quality assurance of environmental measurements in various fields should be directed to the following person(s):

<u>Air Pollution</u>

Mr. Seymour Hochheiser, Chief
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Research Triangle Park, North Carolina 27711

Radiation

Mr. Arthur N. Jarvis, Chief
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National Environmental Research Center
Las Vegas, Nevada 89114

During the months ahead, manuals and documents will be issued which provide guidelines to be followed in all phases of monitoring activities--sampling, analysis, and data handling--and in all media; air, water, and land. Use of these guidelines throughout the Agency will enable a uniform approach to be established within EPA which ultimately can be implemented at the State level. This should permit a significant improvement in the validity and reliability of environmental data which the Nation collects.

The implementation of a total and meaningful national environmental quality assurance effort cannot succeed without the full support of all monitoring programs. Your cooperation is appreciated.

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I. PROGRAM OBJECTIVES

Environmental measurements are made daily by many different Federal, State, local and private agencies. The data from these measurements are used for a wide variety of purposes including assessments of health effects, the establishment of standards and guides, and for enforcement activities. It is therefore imperative that the precision and accuracy of the data be assured in order that policy decisions concerning environmental quality be based on valid and comparable data.

The Quality Assurance Program of the U.S. Environmental Protection Agency is designed to encourage the development and implementation of quality control procedures at all levels of sample collection, analysis, data handling, and reporting. Quality control responsibilities, in the radiation area, have been assigned to the Quality Assurance Branch at the EPA's National Environmental Research Center-Las Vegas. This branch, as an integral part of its overall quality assurance effort, prepares and distributes a variety of calibrated low-level radioactive samples for use in the laboratories of Federal, State, and local agencies.

The major objective of this program is to encourage the development of intralaboratory and interlaboratory quality control procedures and thus insure that the data being supplied to the EPA is valid. Providing accurately calibrated samples assists laboratories in calibrating new instruments, implementing and maintaining routine instrument calibration programs, evaluating analytical procedures, and developing and revising data processing programs.

The following pages briefly describe standard preparation procedures, list the radionuclides available, and indicate how a laboratory may request standards.

If your laboratory does not currently make use of the services offered by the Quality Assurance Branch at the NERC-LV, you are encouraged to do so.

II. PREPARATION AND CALIBRATION OF SAMPLES

Radionuclides, of the best quality available, are used to prepare calibrated samples. These samples are obtained from both governmental and commercial sources. The uncertainty in the known activity of individual sources ranges from 0.5% to 5%. Radionuclide purity, excluding daughters, is better than 99%.

Upon receipt of a radionuclide, it is checked both for its activity and for the presence of radionuclide contamination. If a sample passes this initial inspection, it is diluted with a carrier solution of the same chemical composition and concentration as the original. This is necessary to insure that no loss of activity occurs in the solution due to precipitation or plating. In certain cases the addition of a stabilizer is required. Depending on the particular radionuclide involved, the dilution yields solutions varying in activity from approximately 10,000 disintegrations per minute per gram (dpm/gm) to 50,000 dpm/gm.

To check the accuracy of dilutions, aliquots of alpha or beta emitters are taken from the stock solution, prepared for counting, and their activity determined using appropriate counting instruments. The solution is then pipetted into 5 ml glass ampuls, weighed, and immediately flame sealed. All solutions of gamma-emitting nuclides are pipetted directly into ampuls, weighed, flame sealed, and counted.

Accompanying each calibrated sample is a certificate (Figure 1) listing pertinent information concerning the sample and its calibration including an estimate of the errors associated with the value of the activity. For gamma emitters, a plot (Figure 2) of the pulse height spectrum is also included.

U. S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL ENVIRONMENTAL RESEARCH CENTER-LAS VEGAS
QUALITY ASSURANCE BRANCH

Calibration Certificate

Description

Principal radionuclide | Half-life

Nominal activity | curies

Nominal volume | ml in ampoule/bottle number

Supplied to

Request

SAMPLE

Measurement

Activity of principal radionuclide

Activity per gram of this solution

curies per

at 0400 hours PST on

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

curies per gram

of the daughter nuclide

Total mass of this solution

grams

Total principal activity per gram at the quoted time

curies

Figure 1

Method of measurement

Useful Life

This radionuclide has decayed through [ ] half lives since it was obtained by NERC-LV

We recommend that this solution should not be used after [ ]

Purity

The manufacturer states that activities other than that of the principal nuclide and of its daughter nuclides, if any, were estimated/known to be:

(1)	less than equal to	%	of the principal activity
(2)	less than equal to	%	of the principal activity
(3)	less than equal to	%	of the principal activity

The activity of impurity (1) is [ ] (2) is not (3) is not included in the quoted figures of the principal activity

It is estimated that we have added the following impurities:

(1)	less than		curies/gram
(2)	less than		curies/gram
(3)	less than		curies/gram

SAMPLE

Figure 1 continued

Random Errors

The repeatability of this standardization (dilutions, source preparations, counting statistics, mass determinations, etc.) was such that the certified value of the radioactive concentration of the principle activity had a standard error (σ) not greater than

± [ ] % (The 99.7% confidence limits are given by ± 3σ.)

The total systematic error (sum of estimated maximum residual systematic errors due to dispensing, counting losses, counting corrections, known uncertainty of standard) of the certified radioactive concentration of the principle activity has been estimated not to exceed [+ % (δ)] or [- % (δ')]

The overall limits of error calculated on the basis of + (3σ + δ) or - (3σ + δ') are [+ %] or [- %] of the quoted radioactive concentration.

The effective standard deviation is defined as 1/6th of the range between the overall limits + (3σ + δ) and - (3σ + δ') and is therefore [ ] %

Decay Schemes

This standardization is based on the following assumptions of the principle nuclide, its daughter nuclides and impurities [illegible] for error in these assumptions or the assumption of quoted half-lives [illegible] included in the statement of accuracy above).

SAMPLE

Chemical Composition of Solution

Carrier content per [illegible] of solution: Other components:

Preservative:

Remarks

Date Certificate Prepared _____

Approval Signature _____

Figure 1 continued

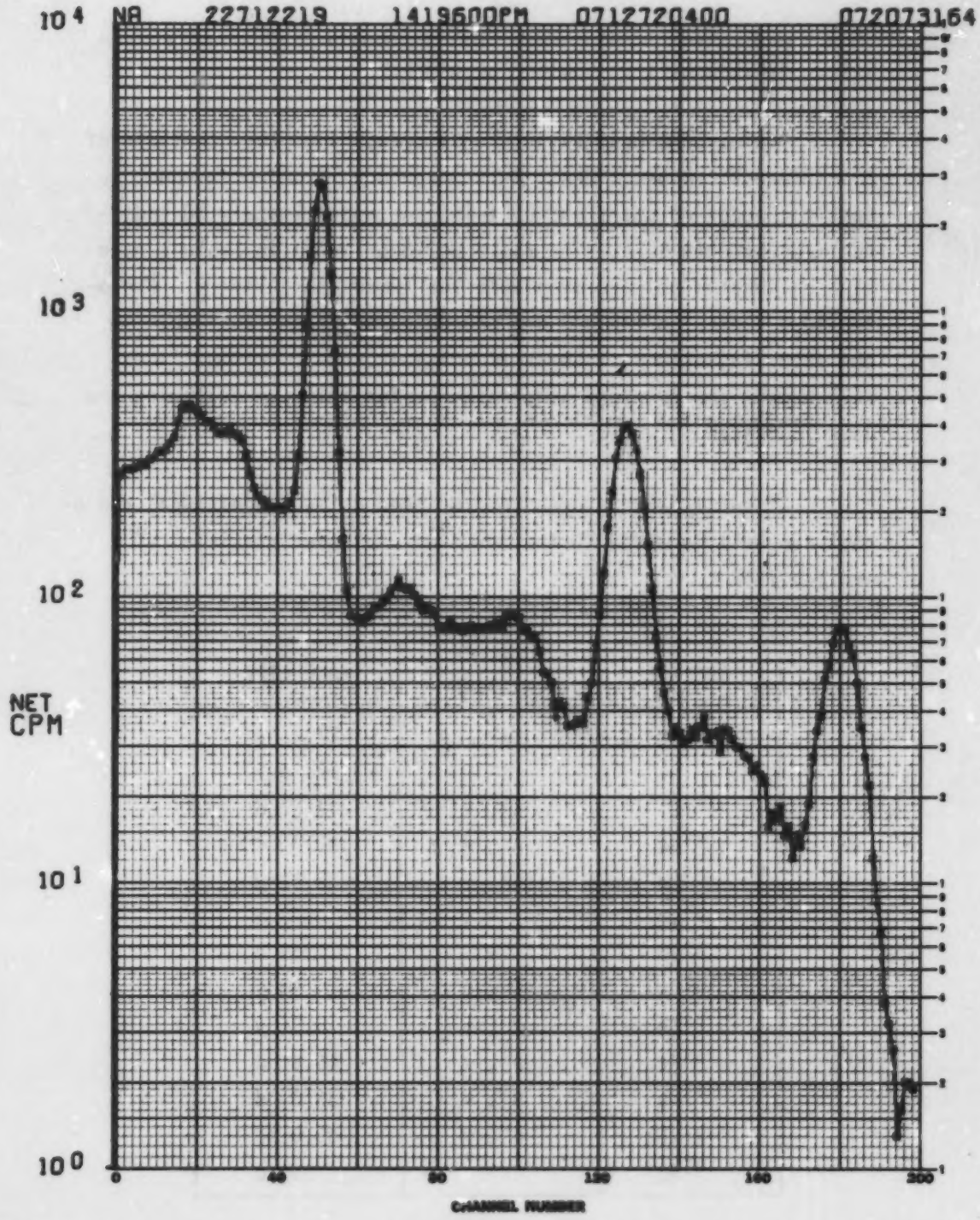

Figure 2. Pulse height spectrum of ^{22}Na measured with 4" x 4" NaI(Tl) Crystal.

III. AVAILABILITY OF CALIBRATED SAMPLES

The current Quality Assurance Branch inventory consists of 30 different radionuclides. This inventory is being expanded to meet the needs of users and will include approximately 50 radionuclides by July 1974. The radionuclides listed in Table 1 have been calibrated and are available for immediate delivery. Radionuclides listed in Table 2 are scheduled to become available on the dates indicated. Insofar as possible, these radionuclides will remain in inventory and available for delivery following the date indicated.

If sufficient interest and/or need arises, additional radionuclides will be added to the inventory and users notified of availability.

Table 1.

NUCLIDE	TYPE OF EMISSION	HALF-LIFE
^{90}Sr	β^-	27.7 y
^{3}H	β^-	12.26 y
^{131}I	β^-, γ	8.05 d
^{140}Ba	β^-, γ	12.8 d
^{22}Na	β^+, γ	2.62 y
^{54}Mn	γ	303 d
^{65}Zn	γ	245 d
^{137}Cs	β^-, γ	30 y
^{60}Co	β^-, γ	5.26 y
^{59}Fe	β^-, γ	45.6 d
^{95}Nb	β^-, γ	35.0 d
^{95}Zr-Nb	β^-, γ	65.5 dd
^{106}Ru	β^-	368 d

Table 2. CALIBRATED SAMPLE DISTRIBUTION SCHEDULE

NUCLIDE	TYPE OF EMISSION	HALF-LIFE†	MONTH AVAILABLE
^{46}Sc	β^-, γ	83.9 d	October 1973
^{85}Sr	γ	64.0 d	"
^{89}Sr	β^-, γ	52.7 d	"
^{203}Hg	β^-, γ	46.9 d	"
^{226}Ra***	α, γ	1602 y	"
^{232}Th***	α	1.41×10^{10} y	"
^{51}Cr	γ	27.8 d	November 1973
^{58}Co	β^+, γ	71.3 d	"
^{75}Se	γ	120 d	"
^{103}Ru	β^-, γ	39.5 d	"
^{124}Sb	β^-, γ	60.4 d	"
^{125}Sb	β^-, γ	2.7 y	"
^{144}Ce	β^-, γ	284 d	"
^{238}U ***	α	4.51×10^{9} y	"
^{239}Pu*	α	24390 y	December 1973
^{241}Am**	α, γ	458 y	"
^{63}Ni	β^-	92 y	"
^{99}Tc	β^-	2.12×10^{5} y	"
^{110m}Ag	β^-, γ	255 d	"
^{134}Cs	β^-, γ	2.04 y	"
^{141}Ce	β^-, γ	32.5 d	"

Table 2 (continued). CALIBRATED SAMPLE DISTRIBUTION SCHEDULE

NUCLIDE	TYPE OF EMISSION	HALF-LIFE†	MONTH AVAILABLE
^{35}S	β^-	87.9 d	January 1974
^{45}Ca	β^-	165 d	"
^{56}Co	β^+, γ	77.3 d	"
^{88}Y	γ	108 d	"
^{109}Cd	γ	453 d	"
^{32}P	β^-	14.3 d	February 1974
^{55}Fe	γ	2.6 y	"
^{133}Ba	γ	10 y	"
^{147}Pm**	β^-	2.62 y	"
^{185}W	β^-	75 d	"
^{204}Tl	β^-	3.81 y	"
^{57}Co	γ	270 d	March 1974
^{125}I	γ	60.2 d	"
^{139}Ce	γ	140 d	"
^{96}Rb	β^-, γ	18.66 d	April 1974
^{182}Ta	β^-, γ	115 d	"
^{195}Au	γ	183 d	May 1974

† Lederer, C., et al., Table of Isotopes, sixth edition, John Wiley and Sons, New York 1967. Recommended half-lives will be indicated on the certificate accompanying each sample.

* Special Nuclear Material License required.

** Byproducts License required.

*** Possible State license required.

IV. PARTICIPATION IN CALIBRATED SAMPLE DISTRIBUTION PROGRAM

Any Federal, State, local or private laboratory involved in, or concerned with, environmental radiation monitoring and surveillance may participate in the calibrated sample distribution program. To request samples, complete one of the request forms included in this publication and return it to:

U.S. Environmental Protection Agency
National Environmental Research Center
Quality Assurance Branch
P.O. Box 15027
Las Vegas, NV 89114

All requests for calibrated samples should be submitted at least 3 weeks in advance in order to insure delivery on date required. Should additional forms be required, they may be requested from the same address.

RADIONUCLIDE REQUEST FORM

TO: U.S. Environmental Protection Agency
National Environmental Research Center
Quality Assurance Branch
P.O. Box 15027
Las Vegas, NV 89114

Please ship the calibrated samples listed below to:

Contact Person _____

Title _____

Laboratory _____

Address _____

_____

Telephone _____

AEC License and/or State License

Type(s) _____

Number(s) _____

NOTE: If either byproducts (in quantities greater than exempt quantities) or special nuclear materials are requested, a copy of the AEC license(s) should accompany the first request.

Radionuclide Samples Desired:

_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

I certify that the calibrated sample(s) requested are to be used only in this laboratory by qualified personnel for the purpose of developing or checking analytical procedures and/or for the calibration of instrumentation.

I further certify that I am authorized to receive the above listed radionuclides under the license number(s) listed above or that this laboratory is exempt from licensing regulations.

Date _____ Signature _____

Title _____

RADIONUCLIDE REQUEST FORM

TO: U.S. Environmental Protection Agency
National Environmental Research Center
Quality Assurance Branch
P.O. Box 15027
Las Vegas, NV 89114

Please ship the calibrated samples listed below to:

Contact Person _____

Title _____

Laboratory _____

Address _____

_____

Telephone _____

AEC License and/or State License

Type(s) _____

Number(s) _____

NOTE: If either byproducts (in quantities greater than exempt quantities) or special nuclear materials are requested, a copy of the AEC license(s) should accompany the first request.

Radionuclide Samples Desired:

_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

I certify that the calibrated sample(s) requested are to be used only in this laboratory by qualified personnel for the purpose of developing or checking analytical procedures and/or for the calibration of instrumentation.

I further certify that I am authorized to receive the above listed radionuclides under the license number(s) listed above or that this laboratory is exempt from licensing regulations.

Date _____ Signature _____

Title _____

RADIONUCLIDE REQUEST FORM

TO: U.S. Environmental Protection Agency
National Environmental Research Center
Quality Assurance Branch
P.O. Box 15027
Las Vegas, NV 89114

Please ship the calibrated samples listed below to:

Contact Person _____

Title _____

Laboratory _____

Address _____

_____

Telephone _____

AEC License and/or State License Type(s) _____

Number(s) _____

NOTE: If either byproducts (in quantities greater than exempt quantities) or special nuclear materials are requested, a copy of the AEC license(s) should accompany the first request.

Radionuclide Samples Desired:

_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

I certify that the calibrated sample(s) requested are to be used only in this laboratory by qualified personnel for the purpose of developing or checking analytical procedures and/or for the calibration of instrumentation.

I further certify that I am authorized to receive the above listed radionuclides under the license number(s) listed above or that this laboratory is exempt from licensing regulations.

Date _____ Signature _____

Title _____